United States Department of Agriculture

FINAL STUDY REPORT
(Big Flats Plant Materials Center, Corning, New York)

Seeding Rates and Harvest Dates on Productivity of 'Tropic Sun' Sunn Hemp in South-Central New York

Shawnna Clark[1/]

ABSTRACT

Sunn hemp (*Crotalaria juncea*) has been touted as a great green manure and cover crop since the 1930s, when it was reported to be an excellent soil-improving crop. The anticipated use of sunn hemp, in the Northeast, is a 45-60 day green manure crop to increase organic matter and N production. A national study was conducted by the Plant Materials Program to determine the areas of the U.S. that show potential to use 'Tropic Sun' sunn hemp for green manure and as a cover crop. Sunn hemp was drilled at 20, 40, and 60 lbs per acre (PLS) and then harvested at 45 and 60 days after planting (DAP). A seeding rate of 20 lb/acre produced significantly lowers yields than the 40 and 60 lb/acre seeding rates. Heights were only significantly different at harvest dates, and after 60 DAP, overall heights were 22 inches taller that plants harvested at 45 days. Seeding rate did not have a significant impact on heights. Delaying harvest 60 DAP produced significantly more biomass than 45 DAP. Harvesting sunn hemp at 60 DAP and seeding at 60 lb/acre increased yield 0.3 more tons per acre than a seeding rate of 40 lb/acre, which produced 1.79 tons/acre. Based on our results seeding Tropic sun between 40-60 lb/acre and delaying harvest for at least 60 DAP produced the most biomass yield.

INTRODUCTION

The Big Flats Plant Materials Center was one of 25 USDA Natural Resources Conservation Service (NRCS) Plant Materials Center (PMC) to participate in a national inter-center strain trial to collect information on the adaptability and use of 'Tropic Sun' sunn hemp in New York. Sunn hemp is a tropical or sub-tropical, warm season legume that is capable of producing high organic matter yields and can fix large amounts of N in a relatively short growth period of 60-90 days after planting (DAP) (Cook and White, 1996). It is used for reducing N application on crops, improving soil health, and as a green manure crop (Mansoer, Z., et.al, 1997). As a cover crop, sunn hemp has the potential to produce 2.5-3.0 tons/acre of biomass in southern climates and 20-140 lbs. of N in the same amount of time (Schomberg,H.H. et. al, 2007). Seeding at the proper rate and management of the residue at critical times are important factors for using Tropic Sun in the northeastern states to improve soil structure N production, reduce soil erosion, weed suppression, and enhance soil organic matter. Objective of this study was to determine the effect of seeding rates and harvest dates on yield of Tropic Sun sunn hemp in south-central New York.

MATERIALS AND METHODS

'Tropic Sun' sunn hemp was seeded on July 7, 2010 on a Unadilla silt loam soil, at the USDA Natural Resources Conservation Service (NRCS) Big Flats Plant Materials Center (PMC), near Corning, New York. This seeding date is an approximate date for planting cover crop between wheat and rye harvest. Sunn hemp seed was obtained from the Hawaii PMC. This seed lot was grown in 2006 with a 90% germination rate. Seed was inoculated with cowpea type *Bradyrhizobium* sp. and planted with a Tye® drill, in 8 inch rows, at 20, 40, and 60 lb/acre, respectively. Yield was determined at approximately 45

[1/] Shawnna Clark, Natural Resource Specialist, USDA-NRCS, Big Flats Plant Materials Center, 607-562-8404

and 60 DAP. The range of seeding rates for this experiment was based around the recommended seeding rate of 'Tropic Sun', which is 30 to 50 lb/acre (Rotar and Joy, 1983). The entire experimental area was 90' by 200'and individual plots were 20' by 30'.

Table 1. Seeding Rate Information

lbs/acre	Seeds/ft^2	lbs/plot	g/Plot	seeds/plot
20	7	0.2	90.8	3000
40	14	0.4	181.6	6000
60	21	0.6	272.4	9000

Table 2. Sources of Variation

Source of Variation	Degrees of Freedom
Rep	4-1=3
Seed rate	4-1= 3
Rep * seed rate	(3) (3)= 9
Clip date	2-1=1
Seed * clip date	(3)(1)=3
Rep*seed rate * clip date	(1)(3)(3)=9

Experimental Design

The experimental design was a randomized complete block arranged as a split-plot with four replicates, where the whole plot treatment was the seeding rates (20, 40, and 60 lbs/acre) and the sub-plot treatment was the harvest dates (45 and 60 DAP). Sources of variation are displayed in Table 2.

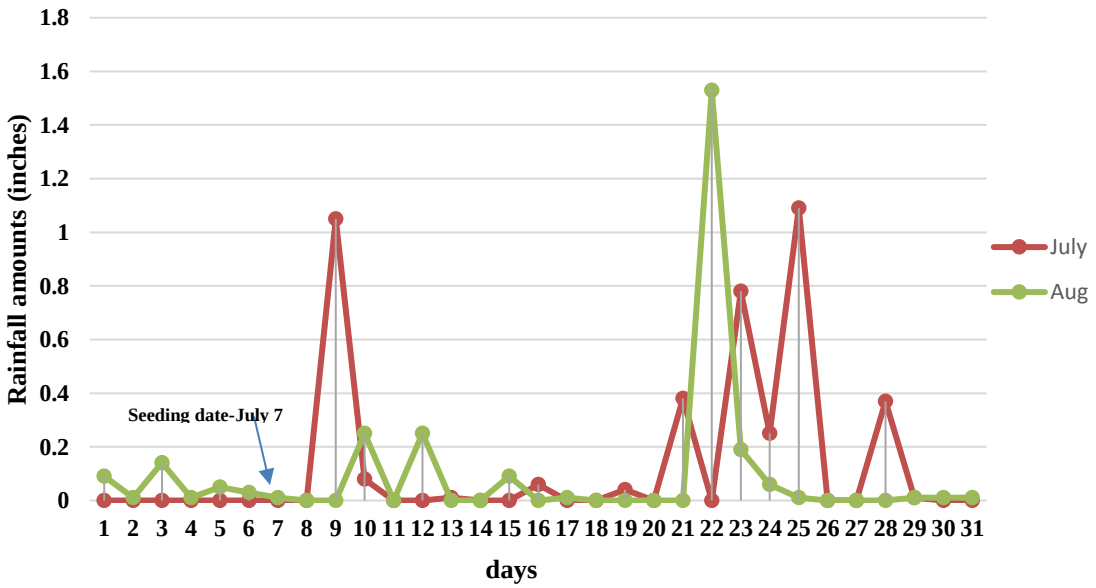

Figure 1. Precipitation amounts during the growing season. Sunn hemp was planted on July 7 and harvested on August 27 and September 9 (not shown).

Data Collection

Two days after the seeding, there was a significant rainfall event, providing adequate soil moisture for germinaton. where 1.1 inches of rain fell in a 24-hr period. Sunn hemp first emerged throughout the plots on July 13, 2010, just 6 days after seeding. (Figure 1). Plant heights and biomass data were collected on August 27, 2010 and September 9, 2010. An average height (inches) was obtained by selecting 3 random plants throughout each plot, at each harvest date. Biomass samples were obtained by taking 2 samples from the center of each plot using a 3-ft x 3 ft. sampling frame. These 2 subsamples were combined for a total fresh weight, and were placed in the greenhouse for 6 days for partial drying, then dried in a drying oven at 76˚C for 24 hours

Data Analysis

Differences between treatments were established using the analysis of variance (ANOVA) for a split-plot treatment and means separation using Fisher's protected least significant difference test (LSD). Protected least significant differences (LSD) at 5% level of probability were determined to compare treatment means when measured traits had significant F-tests ($P \leq 0.05$). Traits analyzed were height and biomass.

RESULTS AND DISCUSSION

Reports indicate sunn hemp plantings that coincide with adequate soil moisture and frost-free, warm-weather conditions provide the most rapid seedling emergence and highest yields (Kundu, 1964; White and Haun, 1965). Two days after seeding sunn hemp, there was a significant rainfall received, over 1 inch, allowing for adequate soil moisture. Seeds germinated uniformly, less than a week after seeding. There was not a significant harvest date by seeding rate interaction (p=0.913) for height or biomass yield. However, there were significant differences in harvest date and height for biomass yield and height (p=0.0047), and differences in seeding rates for biomass yield (p=0.000) (Table 3). A seeding rate of 20 lb/acre produced significantly lowers yields than the 40 and 60 lb/acre seeding rates due to lower number of plants per square foot. Using a rate between 40-60 lbs/acre would be adequate in New York to produce 1.54 to almost 2 tons/acre of aboveground biomass. Seeding at 40 lbs/acre lowers the seeding costs and produced approximately 30% more biomass than the 20 lb/acre rate. As seeding rates increased plant height increased, but the increase was not significant (Table 3).

Delaying harvest sunn hemp at approximately 60 DAP, produced significantly more biomass than 45 DAP. Harvesting sunn hemp at 60 DAP and seeding at 60 lb/acre, produced only 0.3 more tons per acre than a seeding rate of 40 lb/acre, which produced 1.80 tons/acre (Table 4). Based on our results seeding sunn hemp between 40-60 lb/acre and delaying harvest at least 60 DAP produced the most biomass.

Table 3. Sunn Hemp biomass yields and heights at 2 harvest dates and 3 seeding rates USDA-NRCS Corning, NY).

Treatment	Biomass yield	height
Day after planting	---tons/acre---	---inches---
45 †	1.19 B*	44.9 B
60 †	1.68 A	66.7 A
---Seeding Rate, lb/acre---		
20	0.92 B	51.5 A
40	1.54 A	57.5 A
60	1.84 A	58.5 A

Means in columns followed by the same letters are not statistically different as determined by least significant difference test at P<0.05.

† Represents sunn hemp harvest dates. The first harvest date (45 DAP) August 27, 2010, and the second harvest date (60 DAP) September 9, 2010.

Table 4. Biomass yield by seed rate and harvest date interaction of Tropic Sun sunn hemp, USDA-NRCS Big Flats Plant Materials Center, Corning, NY

Seeding rate (lb/acre)	Harvest date	Ave. tons/acre
60	9/9/2010	2.10
40	9/9/2010	1.80
60	8/27/2010	1.68
40	8/27/2010	1.30
20	9/9/2010	1.15
20	8/27/2010	0.70

CONCLUSION

Delaying harvest of Tropic Sun sunn hemp for approximately 60 DAP produced significantly more biomass than 45 DAP. Results suggest that seeding sunn hemp between 40-60 lb/acre and delaying harvest 60 DAP in the Northeast US produced the greatest biomass yield.

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